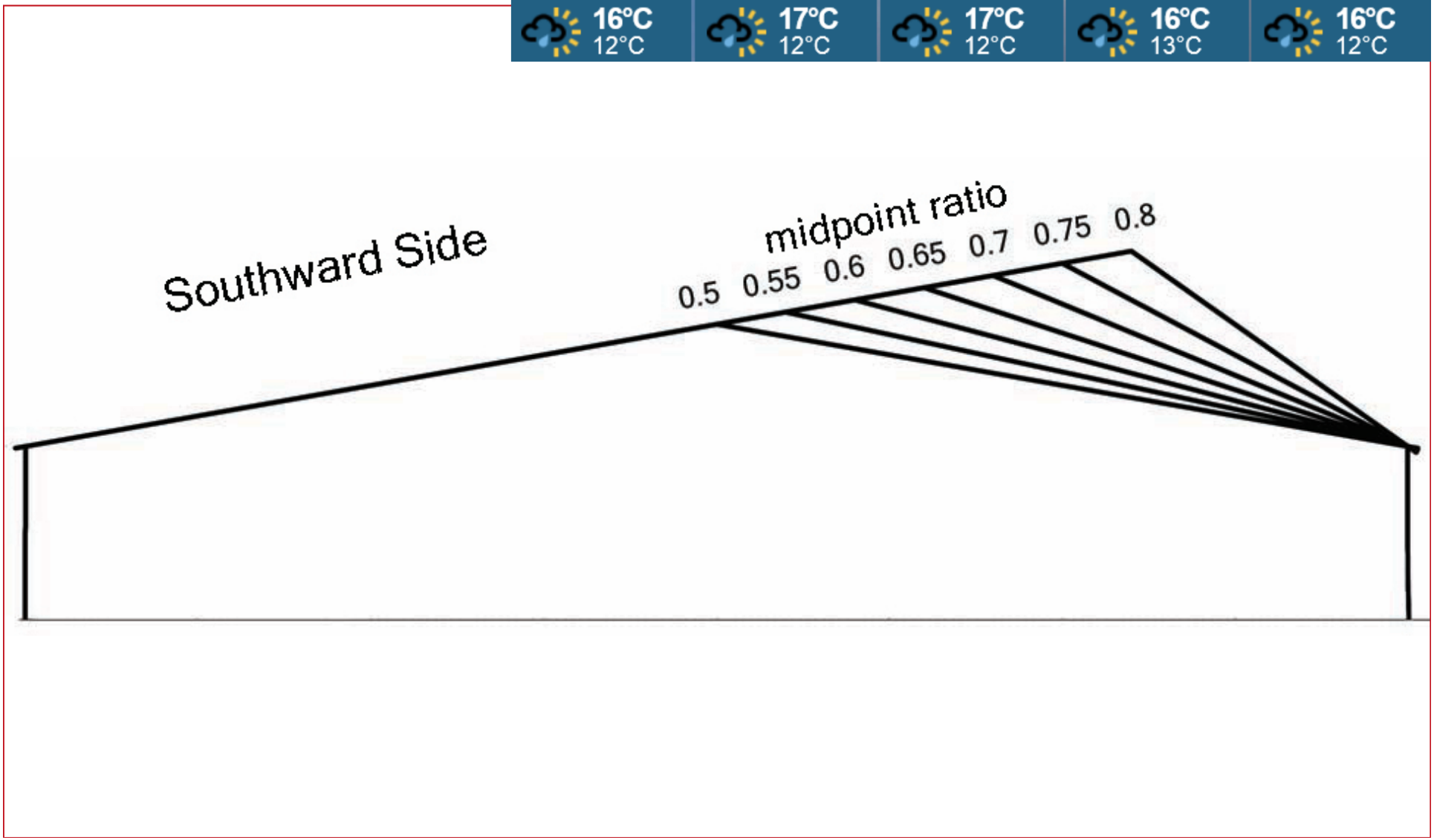
Topographical optimisation of single-storey non-domestic steel framed buildings using photovoltaic panels for zero carbon impact

Topographical optimisation of single-storey non-domestic steel framed buildings using photovoltaic panels for zero carbon impact

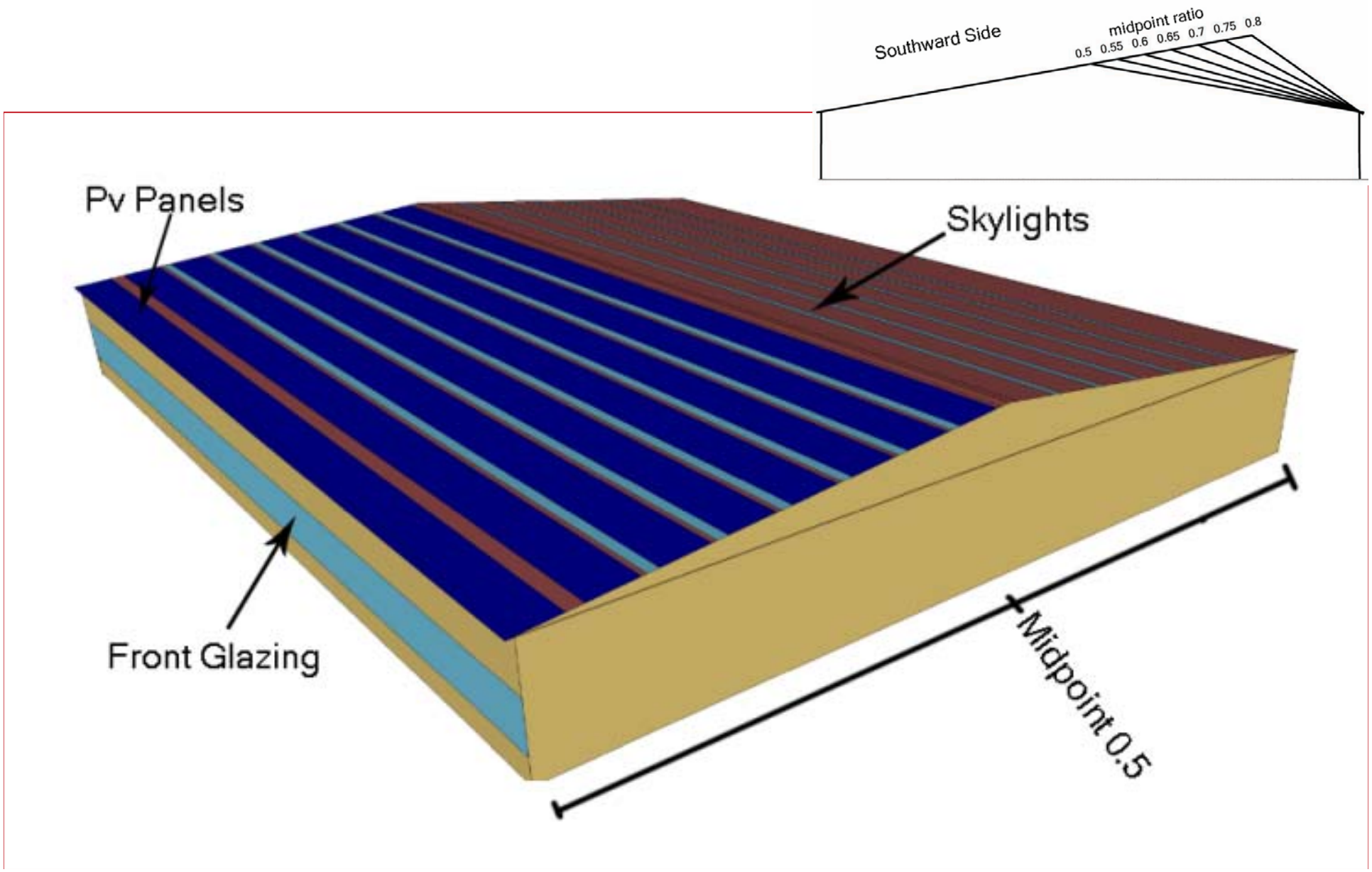
Wei Sha
School of Planning, Architecture and Civil Engineering
Queen's University Belfast

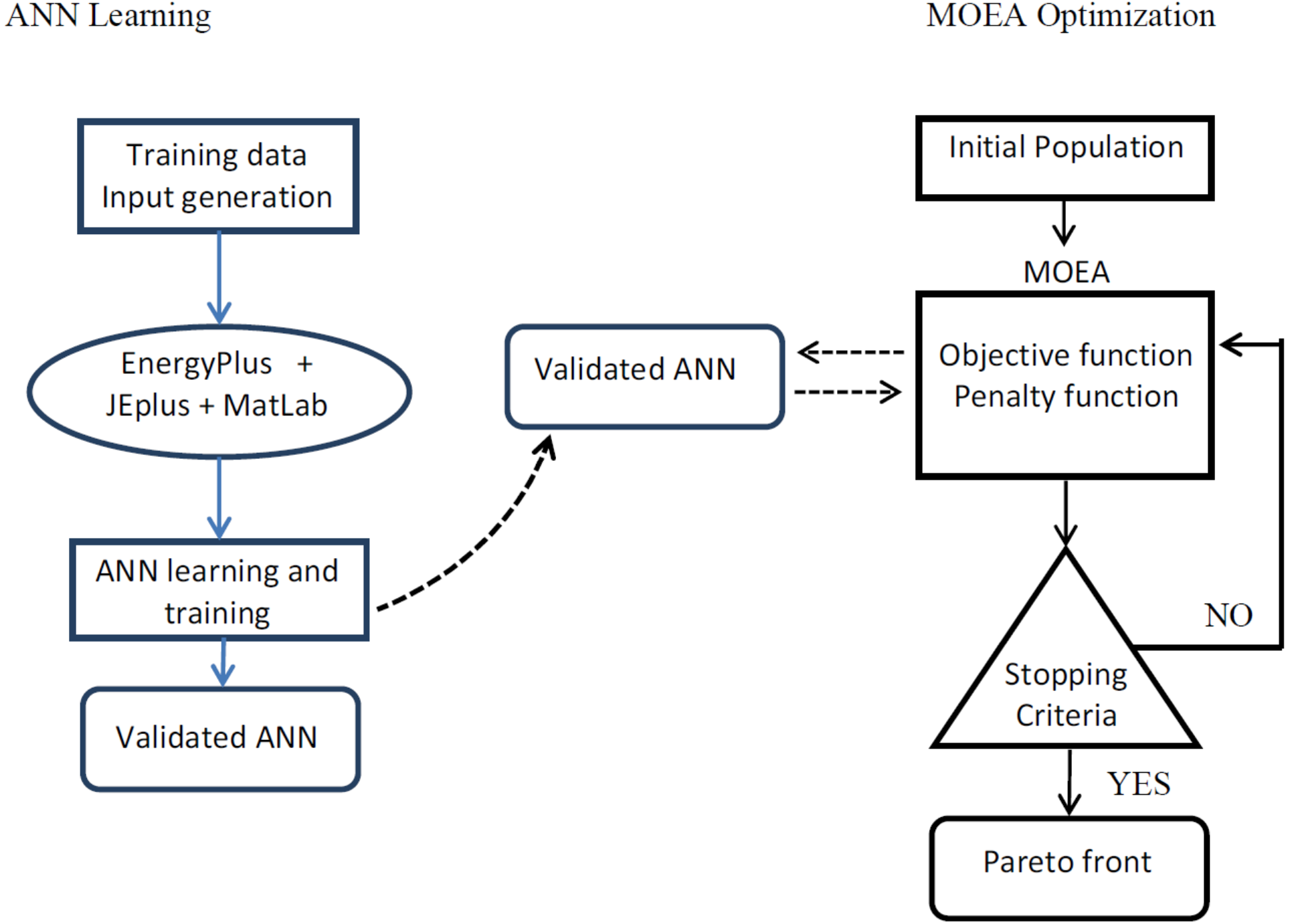
Topographic effect of the midpoint ratio

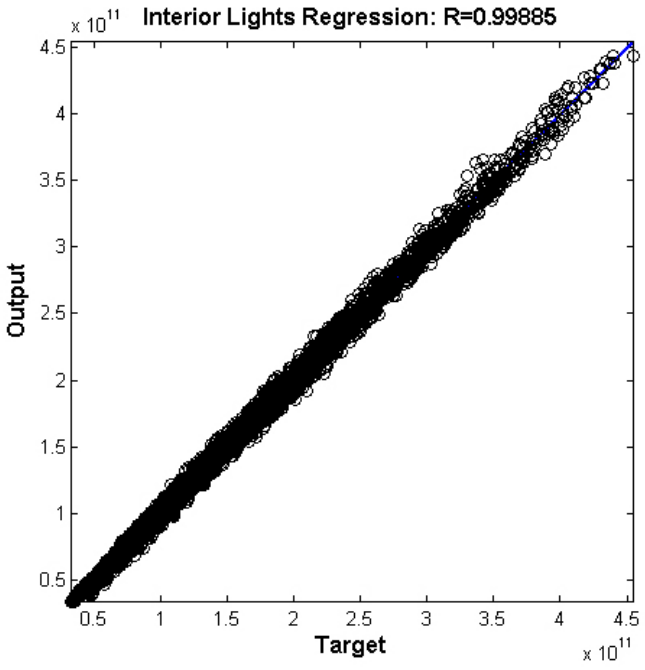
Fri	Sat	Sun 31st	Mon 1st	Tue 2nd
16°C 12°C	17°C 12°C	17°C 12°C	16°C 13°C	16°C 12°C

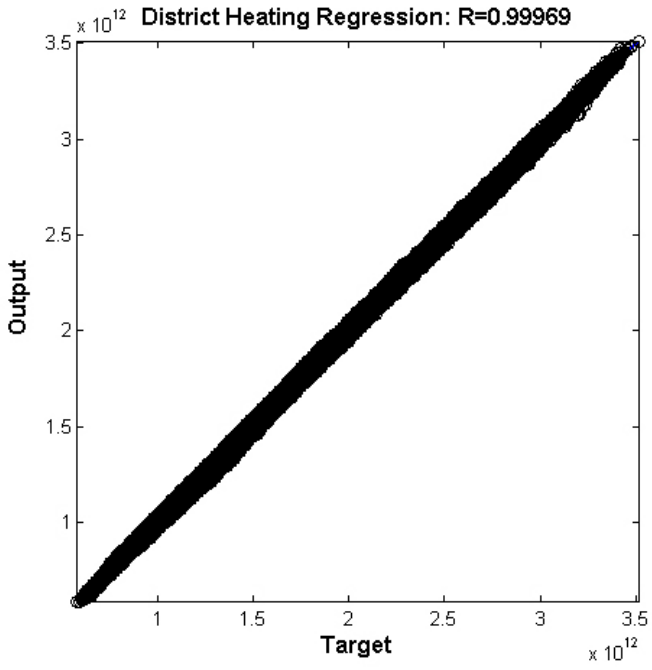


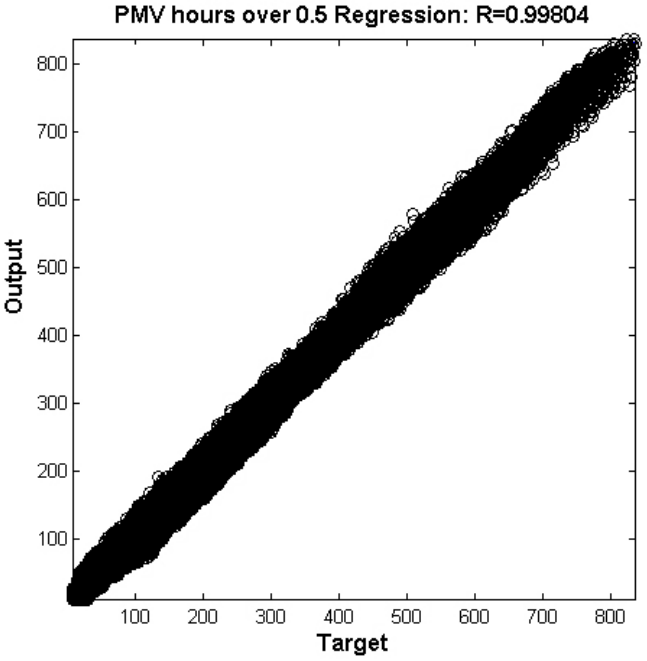
EnergyPlus simulation model representation

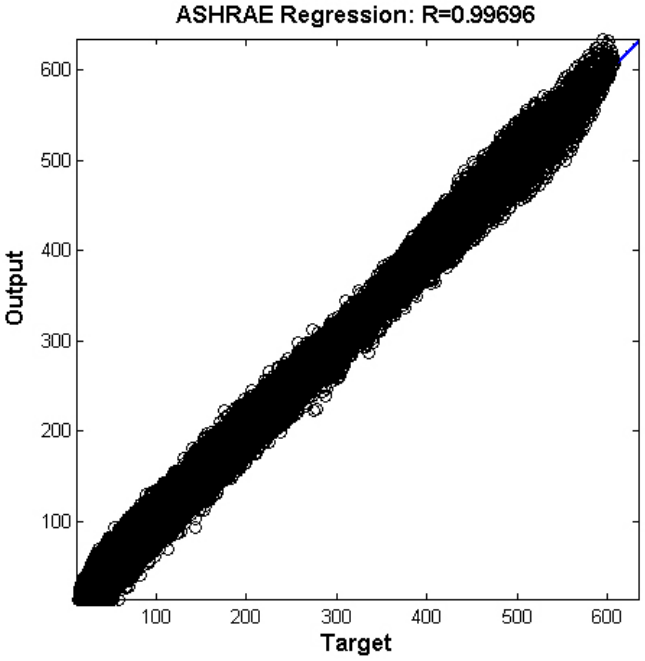



ANN Learning
MOEA Optimization
Training data
Input generation
EnergyPlus +
JEplus + MatLab
ANN learning and
training
Validated ANN
Validated ANN
Initial Population
MOEA
Objective function
Penalty function
Stopping
Criteria
NO
YES
Pareto front







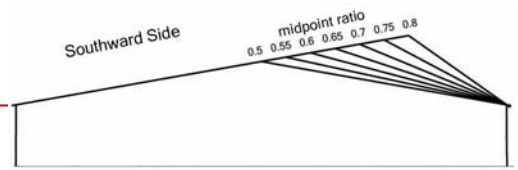


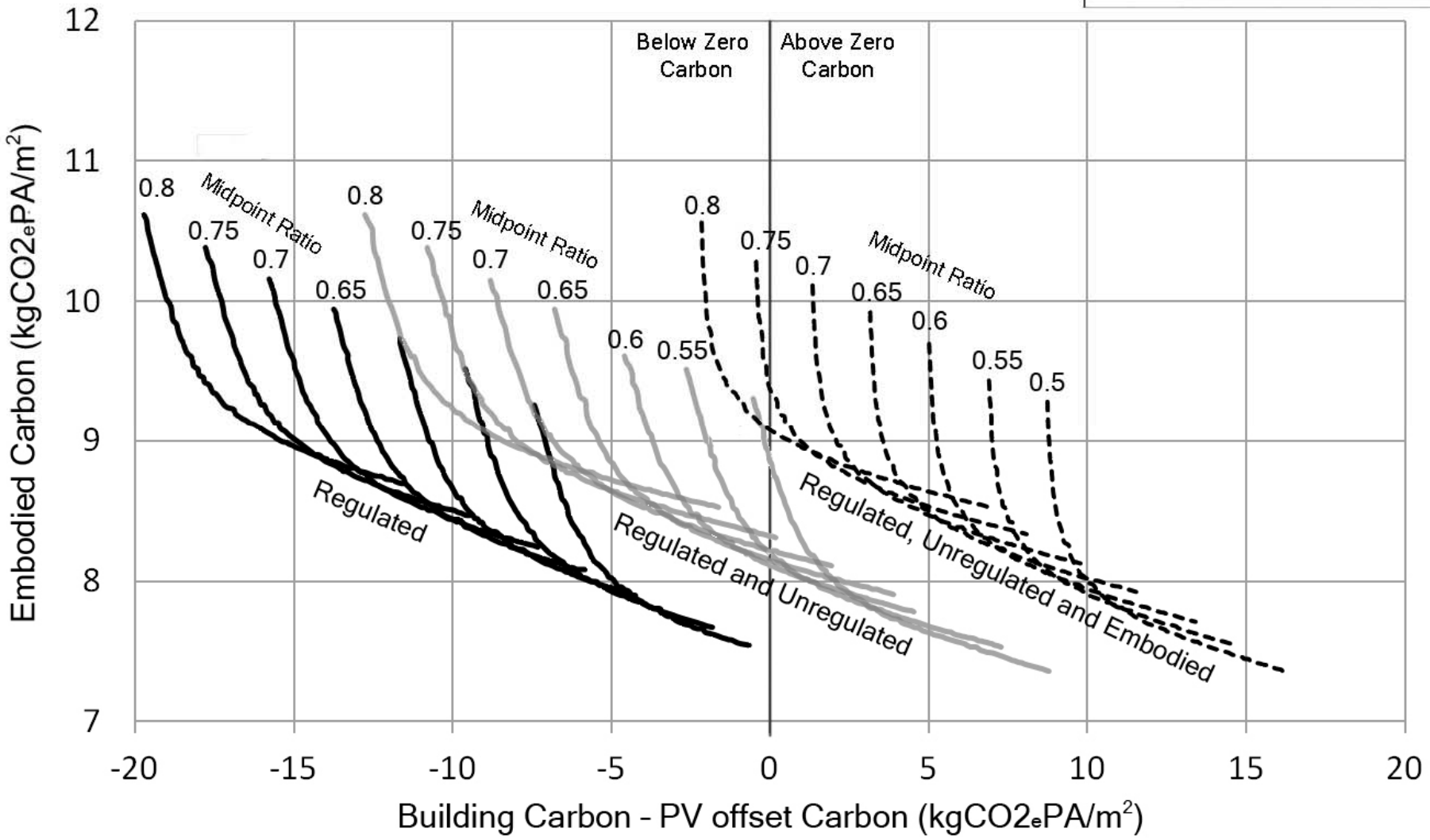
District heating: a system for distributing heat generated in a centralized location.

PMV (predicted mean vote): an index of thermal comfort.

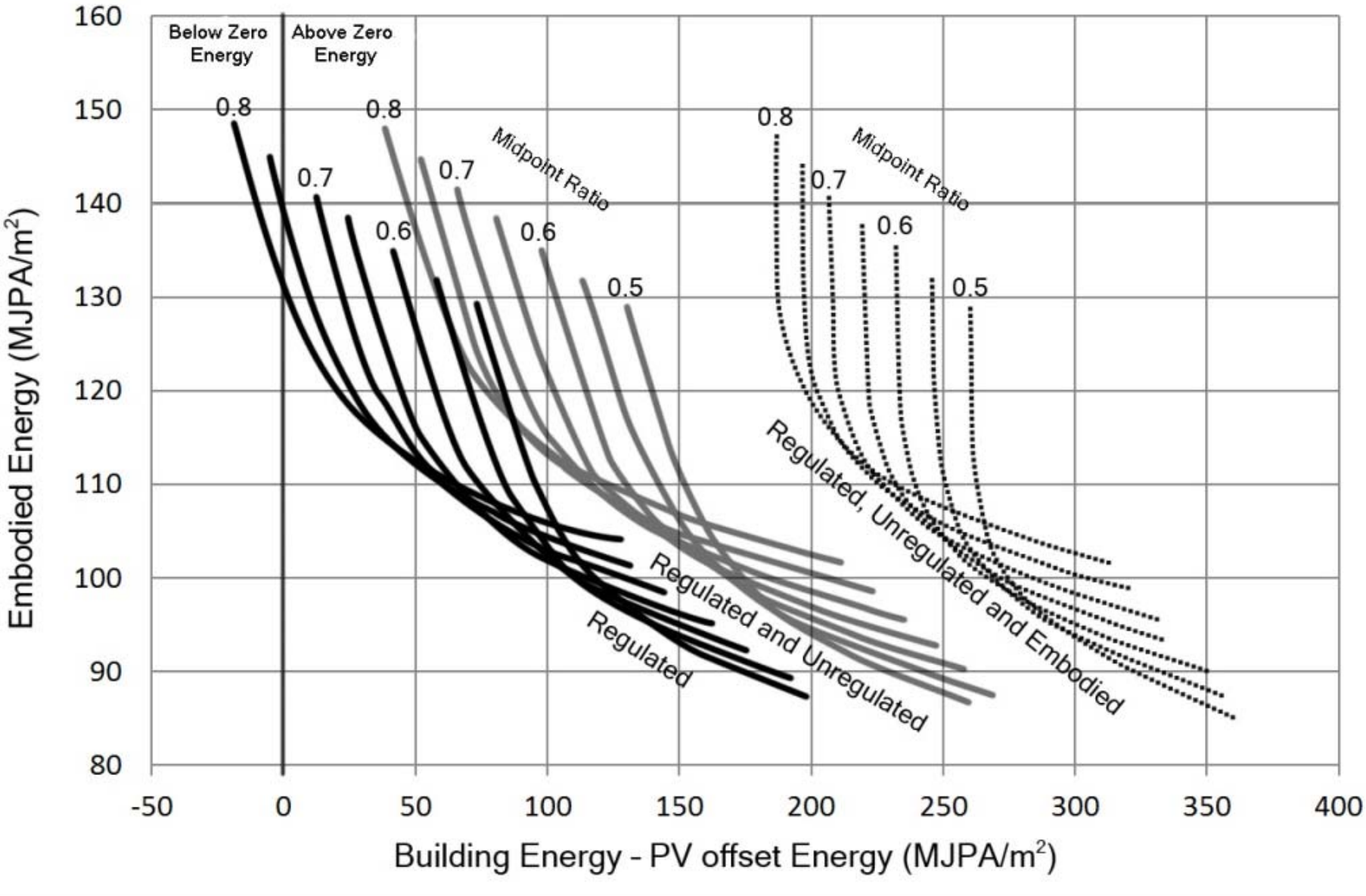
ASHRAE: counting the number of hours discomfort.

Pareto-optimal curves for different midpoint and carbon objectives



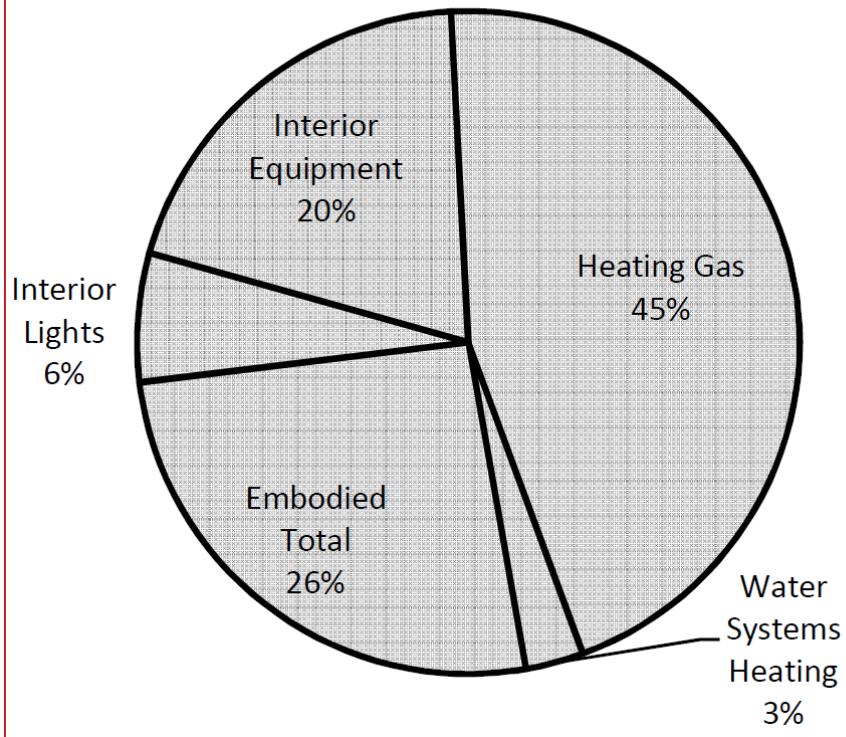


Energy equivalent of the carbon Pareto-optimal curves

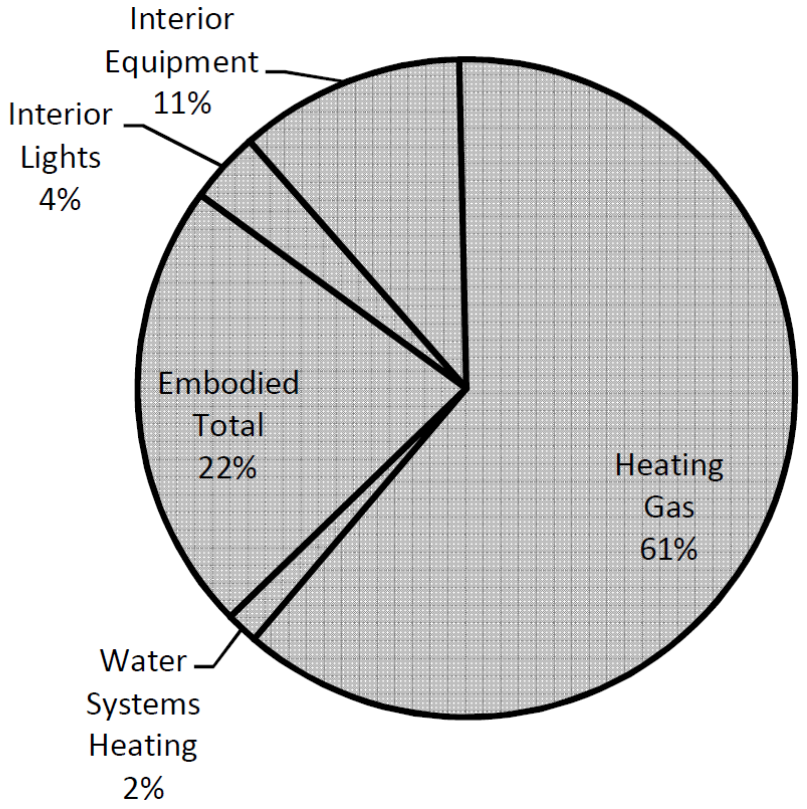


Life time (30 year) breakdown

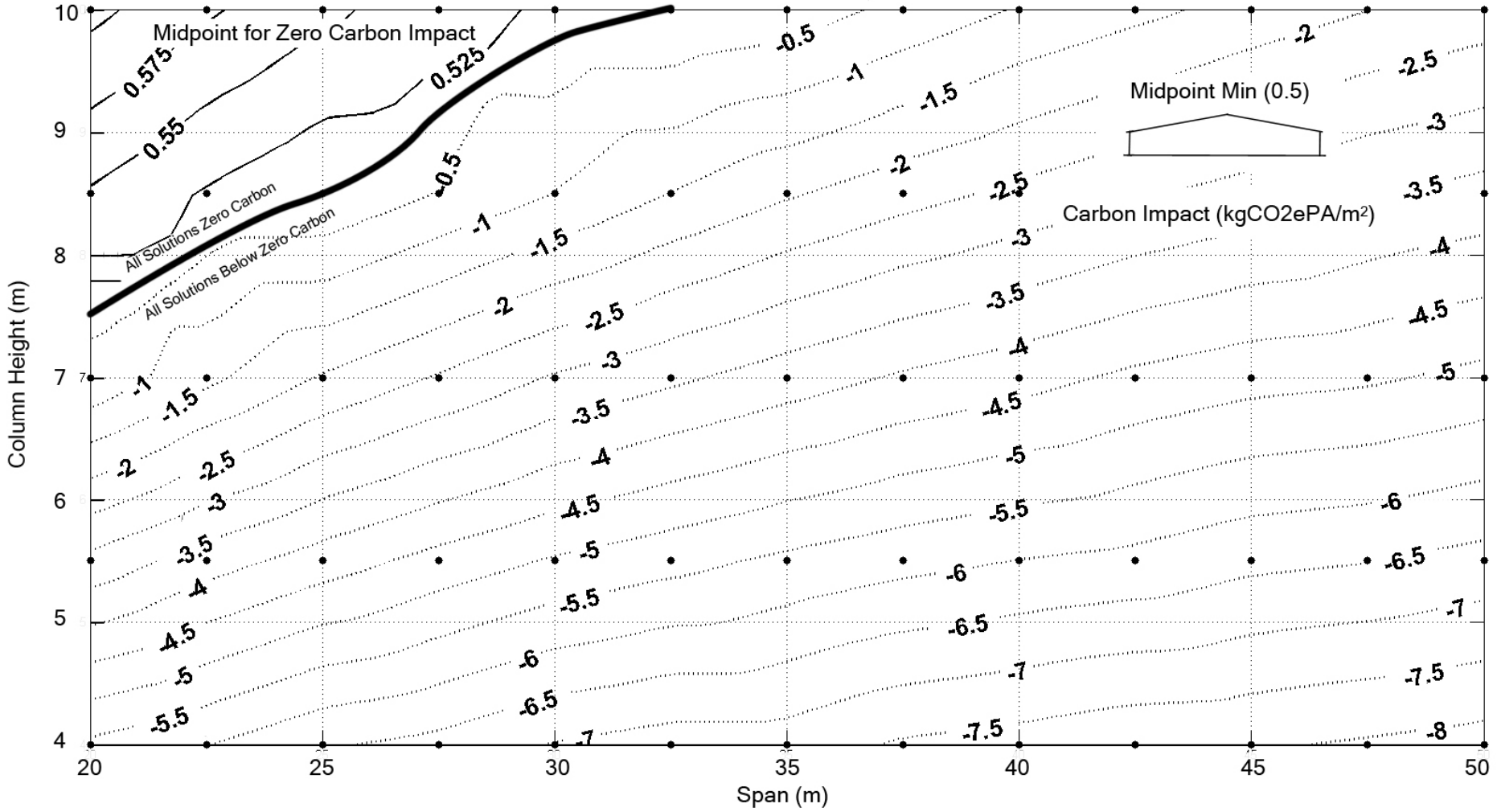
Embodied Carbon



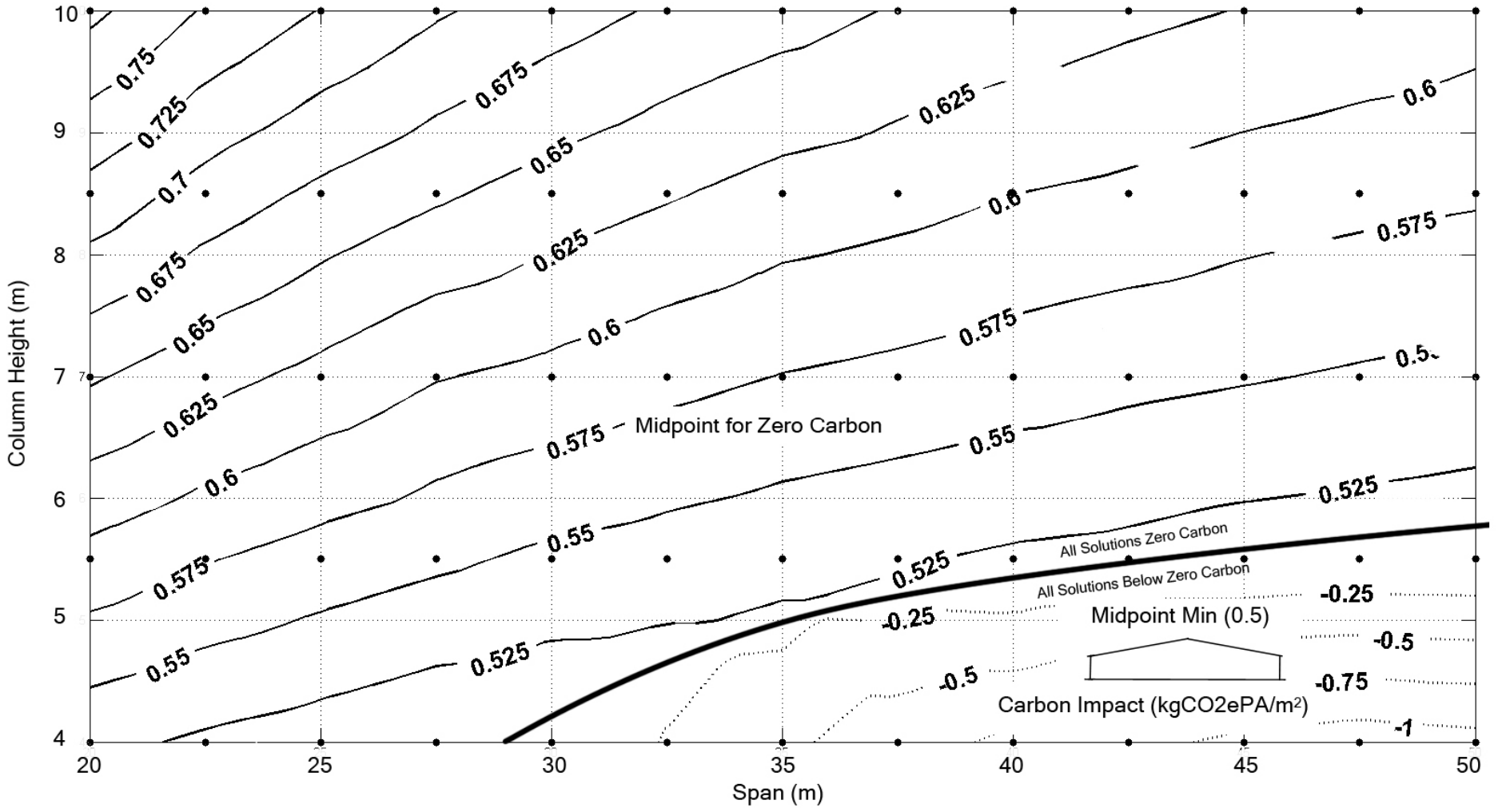
Embodied Energy



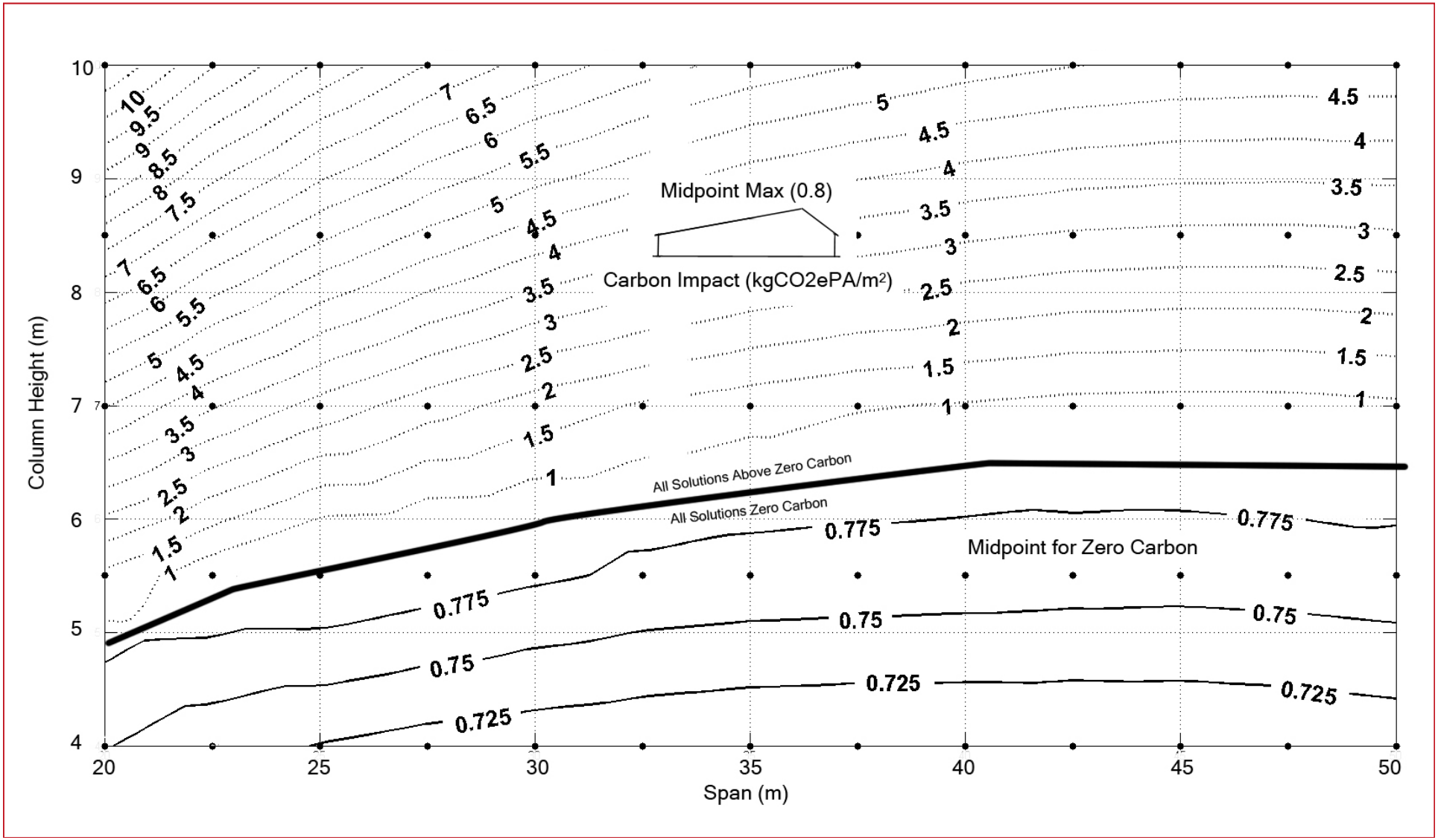
Option 1: regulated carbon offsetting



Option 2: regulated and unregulated carbon offsetting



Option 3: regulated unregulated and embodied carbon offsetting



Acknowledgements

- Ross McKinstray
- James Lim, University of Auckland
- Tiku Tanyimboh, University of Strathclyde
- Duoc Phan, Universiti Tunku Abdul Rahman, Malaysia
- Sandy Brownlee, University of Stirling

Manuscript under review by *Building and Environment*